Astronomy 111 **HW #2** **Fall 2011**

due Thursday, 9/22 in class

1. Infrared detectors are usually operated at very low temperatures, typically 4 K. Explain the advantage of using cold detectors. In space, the entire telescope can also be cooled. What advantages does this bring? Why can't we also cool the telescope optics to the same extent on a ground-based telescope?

2. a) Derive an expression for the parallax of an object viewed with your two eyes. Express distances in cm, and the parallax angle in degrees. Use the **total** apparent angular shift as viewed from each eye (as opposed to ½ this angle, as is done for astronomical parallax). Assume that any distance to which you look is very large compared with the separation between your eyes (which you should measure as best you can).

b) How far away from you is an object whose parallax you observe to be 1 degree?

3. The B-V color of a star refers to its apparent magnitudes in the B and V filters (i.e., m_B-m_V). How does a star's *absolute* B-V (i.e., M_B-M_V) relate to its apparent B-V? Comment on why this is useful in situations where you might not know a star's distance.

4. To demonstrate the relative strength of the electrical and gravitational forces of attraction between the electron and the proton in the Bohr atom, imagine that the hydrogen atom is held together solely by the gravitational force instead of the electromagnetic force. **Determine the radius (in meters) and energy (in eV) of the ground state orbit (n=1), and compare with the values we calculated in class for the real Bohr atom.** For the relevant gravitation formula, see equation 5.13 on page 88 of the textbook (instead of r+r_2 in the denominator, just use R=separation between the proton and electron). Use SI units: For the gravitational constant, G, use: $6.62\text{x}10^{-11}$ m^3-kg^{-1}-s^{-2}; for the mass of the electron, use $9.1\text{x}10^{-31}$ kg, and for the mass of the proton use $1.67\text{x}10^{-27}$ kg. Check on the web for the distance to the most distant galaxy yet observed, and compare this with your answer. (Based on a problem from Carroll & Ostlie's text).

5. Calculate the wavelengths of the following transitions in hydrogen (all of which have been observed in various astronomical objects), **expressing them finally in convenient units and indicating in what part of the electromagnetic spectrum they fall**:

a) Lyman γ (n=4 to n=1) **b)** Balmer δ (= Hδ) (n=6 to n=2)

c) Paschen β (n=5 to n=3) **d)** H109α (n=110 to n=109)

Plus Kutner, Chapter 2:
Question 16
Problems 3, 5*, 23, 26

***Addendum to Kutner problem 5:**

For an increase Δf = 0.05*f, calculate Δm. We can extrapolate from this result that small changes in flux result in similar fractional changes in the magnitude (e.g., a 0.01 (1%) increase in flux → -0.01 change in the magnitude. (Note the minus sign indicating a *brighter* value.)